

ON THE GENUS *DIPHLEBIA*, WITH DESCRIPTIONS
OF NEW SPECIES, AND LIFE-HISTORIES.

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(Plates xix,-xx.)

The genus *Diphlebia* forms one of a group of three closely allied genera united by de Selys to form the sixth legion (*Amphipteryx*) in his classification of the subfamily *Calopterygine*,* — *Devadatta* (*Tetraneura* of Selys), *Amphipteryx*, and *Diphlebia* (*Dineura* of Selys). These are from somewhat widely scattered regions, *Devadatta* occurring in the Malay Peninsula, Lower Siam, and Borneo; *Amphipteryx* in Colombia; and *Diphlebia* in Australia. The characters which distinguish the group from all other genera of the subfamily are the following—No antenodals continued into, or lying in, the subcostal space beyond the level of the arculus. Wings petioled to near level of arculus. Upper side of quadrilateral straight. Basilar space free. Cu_2 distinctly curved at its end. Superior appendages of male distinctly forcipate (de Selys “semi-circulaires”).

The three genera may be clearly distinguished by the following table:—

* Bull. Acad. Royale de Belgique, 1853, pp 66-67; 1859, p.16; 1869, p 18.

| | <i>Devadatta.</i> | <i>Amphipteryx.</i> | <i>Diphlebia.</i> |
|---|--------------------------------------|---|--|
| Number of antenodals prolonged into subcostal space | 4 | 3 | 2 |
| Quadrilateral | 3-celled | free | free |
| Nodus | one-third from wing-base | a little less than one-third from wing-base | a little less than one-half from wing-base |
| M ₂ departing from M ₁ ... | 4-5 cells after nodus | 4-5 cells after nodus | close up to nodus (de Selys "une cellule après le nodus"). |
| Sectors interposed between M ₄ and Cu ₁ | present | absent | present |
| Type | <i>Tetraneura argioides</i> de Selys | <i>Amphipteryx agroides</i> de Selys | <i>Amphipteryx (Dineura) testoides</i> de Selys. |

Each of these genera remained monotypic, until the discovery of *Diphlebia euphaeoides* by me, in North Queensland. In the present paper, two more new species are described, bringing the total number up to four. Besides this, I have been enabled to study the life-history of one of these new species in detail, and have also collected a considerable amount of new information concerning the life-history of *D. lestoïdes* Selys, which fills in the gaps in my original paper on that species.† The facts thus gathered together, afford an opportunity of dealing with the whole genus in one paper, in which the new species may be described, keys given for the differentiation of the four known species, the life-histories of two species related more fully than was before possible, and the characteristics of the genus revised where found necessary.

Descriptions of New Species.—One of these was taken by Mr. F. P. Dodd at Kuranda, in December, 1907. His capture consisted of one mature and one somewhat younger male; the female is not known. The other was first taken by Mr. A. MacCulloch, of the Australian Museum, at Rocky Creek, near Caroda, N.S.W., in 1909. Later on, through the kindness of Mr. A. Mack, of Pallal Station, near Bingara, who invited me to make his home my headquarters for a collecting expedition, I was myself enabled to visit this locality, and to obtain a fine series of the insect, and to study its life-history on the spot.

* "New Australian Species of the Family *Calopterygidae*." These Proceedings, 1907, xxxii., p.394. The name *euphaeoides* was suggested to me by M. René Martin.

† "Life-History of *Diphlebia lestoïdes* Selys." These Proceedings, 1909, xxxiv., pp.370-383.

DIPHLEBIA HYBRIDOIDES, n.sp. (Plate xx., figs. 5 and 9).

♂. *Total length* 52, *abdomen* 40, *hindwing* 33, greatest breadth 7 mm.

Wings: *neuration* black. A broad transverse dark brown band crossing all four wings, from midway between nodus to the beginning or middle of pterostigma. *Pterostigma* 3.3 mm., black. Six *antenodals* on all four wings; *postnodals* 26 on fore, 18-22 on hindwings. *Head*: blackish with two brown occipital spots; labium pale brownish. (The colouring is badly faded. In the live insect the spots are probably blue, and there may be other markings). *Thorax*: *prothorax* black, with two large spots, probably blue. *Meso-* and *metathorax* probably bright blue, with a black dorsal line, and, on each side, narrow antehumeral and lower lateral black stripes (as in all other known species of the genus). *Legs* blackish; measurements of foreleg:—femur 4 mm., tibia 5 mm., tarsus 1.7 mm. *Abdomen* slender, cylindrical; 1-6 tapering very slightly, 7-10 slightly enlarged again. Colour light blue (much faded except in one or two places), marked with black, as far as the pattern is discernible, as follows—1, a transverse basal bar; 2, a fine dorsal line and large cross-piece, one-fourth from apex of segment; 3, a fine dorsal line along basal third of segment; 3-6, two small slanting lines near apex; 5-6, two faint dots near base; 7-9, clear blue all over; 10, blue, probably shaded apically with brown or black. *Appendages*: *superior* 1.6 mm., forcepate, very slender, tapering to tips, black (or, possibly, blue in the living insect); a large inferior tooth or spine one-third from base; inner margin finely serrated near tips, outer margin with small dense hairs. Seen sideways, they are remarkably upcurved. *Inferior* 0.3 mm., thick, subtruncate, black, with an inner pointed projecting portion (Plate xx., figs. 5a, b).

A second male, evidently less mature, has the transverse banding on the wings very pale.

♀. Unknown.

Hab.—Kuranda, North Queensland.

Type ♂, and cotype ♂, in my collection, taken by Mr. F. P. Dodd(December, 1907).

This species can be distinguished, at once, from all other species of the genus by *the large inferior spine on the superior appendages*, also by the slenderness of the appendages towards the tips, and their upcurvedness when viewed sideways. In colouration, it resembles *D. lestoides*, but the shape of the abdomen is closer to that of *D. euphrooides*. The banding of the wings may also be considered as intermediate between the narrow milky band of *D. lestoides* and the deep, almost black, shading of *D. euphrooides*, which nearly covers the wing. For these reasons, I have proposed the name *D. hybridoides* for this species.

Owing to the excessive summer rains of the past few years in North Queensland, no further specimens of this interesting insect have been taken. But as the locality is now known, it is to be hoped that the unknown female and less faded males will soon be discovered.

DIPHLEBIA NYMPHOIDES, n.sp. (Plate xx., figs.4, 8).

♂. *Total length* 50, *abdomen* 35, *hindwing* 31, *greatest breadth* 6 mm.

Wings: *neuration* dark brown, the whole wing suffused with a transparent brownish tint. *Subcostal space* very narrow, the subcostal and radio-median nervures *practically fused up to arculus*; *pterostigma* 4 mm., black. Six to seven antenodals and 25-30 postnodals on all four wings. *Head*: *eyes* black; *vertex* black, hairy; *front*, *labrum*, and *labium* black. *Thorax*: *prothorax* velvety black; conspicuous basal and apical collars of bright blue, also two large oval spots of the same colour. *Meso- and meta-thorax* brilliant blue, with dorsal band and collar of jet black; on each side a straight black antehumeral stripe and a lower lateral black stripe, both narrow; underside tinged with grey and pink; wing-bases with large blue spots; notum black spotted with blue. *Legs* black, underside of femora pinkish. Measurements of femur, tibia and tarsus respectively are—foreleg, 4·4-5·1-7 mm.; middle

leg 5·5·5·2 mm.; hind leg 7·5·5·2 mm. Abdomen slender, subcylindrical, 1-3 slightly enlarged, 4-10 quite cylindrical. Colour brilliant blue, marked with jet black as follows—1, a transverse basal band; 2, a narrow transverse basal band, a fine dorsal line crossed about one-third from apex of segment by a short cross-piece; 3, a fine dorsal line spreading apically into a large diamond-shaped patch; 4-7, a thick convexly curved dorsal band spreading so as to cover the whole of the apical fourth of the segment; 8, a narrower and straighter dorsal band, spreading as in 4-7; 9, a large semicircular basal patch, from which projects a sharp dorsal spike; 10, black with two large oval blue spots. Appendages: *superior* 2 mm., forcipate, black, rough and spiny, narrowed about the middle; tips rather broadened and rounded; seen sideways, the tips are enlarged downwards. *Inferior* 0·5 mm., black, close together, well-rounded and almost touching at tips; seen sideways, they appear truncated (Plate xx., figs. 4a, b).

♀. *Total length* 47, *abdomen* 33, *hindwing* 33, greatest breadth 6 mm.

Wings: *pterostigma* 3·5 mm., cream-coloured between black nervures; *subcostal space* paler and wider than in male, with the subcostal and radio-median nervures quite distinct from bases onwards. *Head*: *eyes* brown bordered inwards with cream-colour; *vertex* hairy, blackish, with four brown spots, the front pair rather small and rounded, the back pair larger, elongate irregular subtriangular (Plate xix., fig. 11); *front* brown, hairy; *clypeus* brownish edged with black; *labrum* very pale brown bordered with black, and with a fine short central black line; *labium* pale dirty brownish; *mouth* black. *Thorax*: *prothorax* and upper part of *thorax* as in male, but with the blue colour replaced by dark brown; *sides* pale greyish touched with fawn-colour, with a narrow lateral black band; *notum* dark brown with paler spots. *Legs*: *coxæ* and undersides of femora whitish; femora pale brown darkening to blackish; rest dull blackish. Abdomen subcylindrical, 1-3 slightly enlarged, 4-7 somewhat tapering, 8-10 slightly enlarged again. Colour brown; 1, whitish on sides; 2-3, a medium brown with black sutures, a fine black

dorsal line crossed at one-fourth from apex by a flattened triangular or diamond-shaped mark; 4-7, like 3, but much darker, dorsal line thicker and apical mark less regular; sutures black, wider on sides, a long black bar low down on each side of 4-6, a short bar on 7; 8, dark brown, paler on sides; 9, almost black basally, touched with brown apically and on sides; 10 very pale brownish, with black dorsal line. Appendages 1 mm., blackish, conical, sharply pointed.

Hab. — Rocky Creek, near Caroda; Nandewar Ranges, N.S.W.; also (less commonly) Pallal Creek, near Bingara, N.S.W. (December, 1910).

Types: ♂♀, and series of cotypes in my collection, taken by myself, in above localities.

The two localities given are only a few miles apart, and both are tributaries of the Horton River, which joins the Gwydir near Bingara. The insect frequents only the rocky parts of the creeks, and is absent from the lower part of Pallal Creek, and from the Horton River itself. It is one of the most beautiful and brilliant insects known to me, the blue of its body far out-rivalling the colour of *D. lestoides*, itself a brilliant insect. I have therefore chosen the name *nymphoides* (Greek *νύμφη*, a bride) in allusion to its beauty.

Comparison of the Four Known Species.

The four known species, *D. lestoides* Selys, *D. euphœoides* Tillyard, *D. hybridoides*, n.sp., and *D. nymphoides*, n.sp., are all closely allied, and form a homogeneous and natural Australian genus. The following table gives the most important differences for the males :—

| | <i>D. lestoides</i> ♂ | <i>D. euphaoides</i> ♂ | <i>D. hybridoides</i> ♂ | <i>D. nymphoides</i> ♂. |
|----------|--|---|--|---|
| Wings: | narrow milky band (sometimes absent) | opaque black shading nearly covering wing | broad brown band towards apex | transparent light brown tint all over |
| Abdomen: | 1-2 hairy | 1-2 not hairy | 1-2 not hairy | 1-2 not hairy |
| Shape: | cylindrical, rather broad and flattish | narrow and rounded | narrow and rounded, longer than <i>D. euphaoides</i> | medium width, fairly rounded, cylindrical |
| Colour: | bright blue, with very little black | 1-3 and 8-9 only, bright blue; rest jet black | bright blue, with very little black | brilliant blue with broad and conspicuous black pattern |

[For comparison of abdomen, see Plate xx., figs. 6-9; two varieties of the very variable *D. lestoides* are given, 6a from Snowy River, Jindabyne; 6b from Heathcote, Illawarra, N.S.W.].

Superior Appendages: thick, flattish, of equal width all along, pale blue (fading to black in dead insect)

most like *D. euphaoides*, narrow in middle, tips rounded, black (inferior appendages shorter and smaller than in *D. euphaoides*.)

[For comparison of male appendages, see Plate xx., figs.2-5. These appendages are very thick and of rough surface, being covered all over with tiny spines and other irregularities; hence they are exceedingly difficult to represent by a camera-lucida drawing. In determining a species, therefore, by means of these appendages, one must be prepared for individuals of the same species showing minor differences, which may be due either to the individual itself, or more probably to the particular angle from which the appendages are drawn, the outline of the thick inferior appendages especially changing rapidly with the angle of vision.]

To separate the three known females (that of *D. hybridoides* being so far undiscovered) is a more difficult task. The prothoracic differences seem scarcely sufficient to rely upon, and the same may be said of the structure of the occiput. The male appendages being very similar in plan, we might reasonably infer this to be the case with the occiput and prothorax of the females. The best criteria seem to me to be—(1) the epicranial pattern; (2) the measurements of the tibia of the fore-leg; (3) the comparative length and breadth of the wings; (4) the shape of the abdomen.

(1). The epicranial colouration is a brown pattern on a black ground. This pattern may be divided into two parts - *a*, the vertical spots, of which there are two, lying between the antennal base and the basal ocellus on each side of the main longitudinal axis; *b*, the postocellar or occipital band, lying close to the occipital ridge between the eyes.

In *D. lestoides* ♀, and *D. nymphoides* ♀, the vertical spots are very distinct and rounded, but those of *D. lestoides* have a tendency to a subtriangular shape. In *D. euphroides* ♀, however, the spots are enlarged into elongated, subtriangular patches which are joined by a stalk to the brown edging of the eyes.

In *D. lestoides* ♀ and *D. euphroides* ♀ the occipital band is regular, rounded and slightly enlarged at each end, and with a tendency in *D. euphroides* ♀ to carry a small central spike pointing forward. In *D. nymphoides* ♀ the occipital band is broken and divided into two very irregular, subtriangular patches, notched about the middle forwards (see Plate xix., figs.9-11).

These epicranial patterns are, of course, subject to slight individual variation, but are sufficiently constant to be relied upon.

(2). *D. lestoides* ♀ can be recognised at once by the great length of its fore-legs. The measurements for the tibiae are—*D. lestoides* ♀ 7; *D. euphaeoides* ♀ 4.5; *D. nymphoides* ♀ 5 mm.

(3). The measurements for the hindwing are—*D. lestoides* ♀ 34-35 long, greatest breadth 6; *D. euphaeoides* ♀ 32 by 6; *D. nymphoides* 32 by 6.2 mm.

(4). In comparing the abdomens of the three females, that of *D. lestoides* is seen to be very cylindrical, somewhat flattened, and much broader than either of the others; that of *D. euphaeoides* is distinctly narrow and rounded; while that of *D. nymphoides* is of intermediate breadth and roundness.

Besides these differences, it may be remarked that the pterostigma of *D. euphaeoides* is narrower and slightly shorter than those of the other two. In the whole of my series of *D. nymphoides* ♀, the pterostigmas are uniformly pale cream-colour between black nervures; those of *D. lestoides* ♀ are usually so, and those of *D. euphaeoides* much darker. These differences, however, cannot be pressed, as we do not know what changes may take place in the colouration as the insects become more and more mature.

Life-Histories of D. lestoides Selys., and *D. nymphoides*, n.sp.

In my former paper on the life-history of *D. lestoides*,* I was compelled to leave some unavoidable gaps in the record, as I had been unable to find the full-fed nymph, and could only surmise what its habits might be. The beds of the mountain-creeks of the Rodriguez Pass and other parts of the Blue Mountains, and also the Heatcote Creek and Woronora River in the Illawarra district, (the places where I studied this species) are remarkable in consisting almost entirely of solid bed-rock. The detached rocks and boulders are mostly of great size, and quite immovable. There were none of the flat or rounded rocks of medium size that so often occur in rapid streams. I made it my object to search

* These Proceedings, 1909, xxxiv., p.370.

for these latter, in the hope that, by turning one of them over, I might find the larva clinging to the underside. During two visits to Heathcote with a friend, our united efforts succeeded in overturning several large boulders, but without any sign of the larva; if it were there, it either got washed off in the swirl of water, or succeeded in escaping before we overturned the rock. However, fortune at last came my way. While dredging with a flat, triangular net along the smooth rock-bottom of the creek at Medlow, Blue Mountains, just above the lake, on November 13th, 1909, I dislodged a small flat slab of rock into my net. On the underside of this I found a well-grown larva of *D. lestoides*. This is the only larva of this species that I have ever found. A figure of it is given in Plate xix., fig.1. I kept this in a small jar until the beginning of January, 1910. It fed well, and usually sat still at the base of a stick. It showed very little activity, and its huge caudal gills seemed to be very cumbersome, and much in the way when it was moving. About the beginning of December it changed its skin. When it appeared to be full-fed, I killed it with chloroform, carefully extracted the gizzard, and mounted it in alcohol. A description of this larva is given below.

On December 14th, 1910, during my collecting trip to the north-west of New South Wales, I visited Rocky Creek, near Caroda, on the edge of the Nandewar Ranges. This is a splendid collecting ground, and I found the beautiful *D. nymphoides*, n.sp., in sufficient numbers to lead me to hope that I might obtain the larva. At the point where I struck the creek, just above some big falls, the bed consisted of solid basaltic rock, with huge vertical-sided boulders standing up in many places. I carefully searched the sides and crevices of these rocks, and obtained two cast-skins, but no living nymphs. Further up, the character of the creek changed, and I found a long stretch of clear water rippling over small rocks and pebbles. Here the creek was overhung with green trees and bushes. In such a setting, this glorious new *Diphlebia*, resting on rocks, skimming the surface of the water, or perching, several in a row, along the outstretched, bare branches of shrubs, made a picture that I shall never forget. On one horizontal bough, I counted no less than seven brilliantly-

coloured males, perched about a foot apart, and all sitting in exactly the same attitude, with wings outspread horizontally, body held straight out, also horizontally, and at an angle of about 60° to the bough.

In this part of the creek, the rocks were easily lifted and overturned. At the very first try, I found two full-fed larvæ under a fair-sized rock. The next dozen rocks or so yielded nothing, and then, on a smaller rock, I found a peculiar *Aeschnid* larva that seemed to be *Caliaeschna conspersa*. Somewhat higher up the creek, under some rocks only half-covered by water, I took three more *Diphlebia*-larvæ. Having examined some fifty or sixty rocks during the afternoon, I finished up with seventeen *Diphlebia* larvæ, all nearly full fed, and four *Aeschnid* larvæ. Besides these, I found two female *Diphlebia* emerging, and observed no less than three of them ovipositing under the water, just in the same way as I have already described for the female of *D. lestoides*. The eggs were found in the tissues of the water-weed, and were of the same size and shape as those of *D. lestoides* already described. I also spent some time looking for young larvæ, and found over a dozen, from about 2 to 6 mm. in length, on various rocks. Some of these young larvæ were on the same rocks as the full-fed larvæ, and I think it is quite likely that the earliest-hatched of the new brood fall victims in large numbers to the rapacity of the later members of the old brood.

The young larvæ were of a pale semitransparent whitish colour, with narrow gills; in appearance, almost exactly like the young larva of *D. lestoides* figured in my former paper (*q.v.* p.376 and fig.4). They were fairly active, running away and hiding in small crevices and depressions in the rocks. Unfortunately it was impossible to keep any of these alive during the long rough journey back to Sydney, so that I was unable to follow up the changes through the different stages of growth. By the time the larva has grown to a considerable size, the colour has become a dark shining greyish-black. I was particularly struck with the helplessness of the larger larvæ as soon as they were lifted out of the water. Their huge, cumbersome, caudal gills made it almost impossible for them to get along, for they stuck to the wet rock,

so that the larvæ could only crawl slowly and helplessly along, trying always, like an iguana, to get on the side of the rock away from me. I tried several times to see how they behaved under water. To do this, I took a rock to which a larva was clinging, and lowered it gently into the water, watching the larva carefully. I found that, under water, they could move with more rapidity, but I was easily able to follow them with my hand, and catch them again merely by feeling for them. Occasionally one got detached from a stone, when it would spread out its legs and caudal gills, and rock itself slowly to and fro, gradually sinking the while. These observations satisfied me that the larva was purely a *rock-liver*, and that, once detached from its refuge, it was a hopelessly clumsy creature. As was evident from the form of the legs and abdomen even in the exuviae, the whole insect is built so as to be able to cling flatly and closely to the rock-surface, where it is able to lie concealed, and capture its prey in the running water.

The emergence of *D. nymphoides* is very similar to that of *Austrogomphus heteroclitus*, a species which was emerging in great numbers on the same creek. Both larvæ climb up the rocks, just above water-level, and emerge there, only the *Diphlebia* prefers the vertical or overhanging surfaces, facing down-stream, so as to be away from the current; while the *Austrogomphus* usually chooses a more slanting surface, often on the up-stream side, so that it gets washed by the little wavelets and ripples, and is thus apparently helped upwards along the rock. The newly emerged insects, in both cases, rest only just out of reach of the water, and fly straight off into the bush as soon as their wings are dry enough.

Three of the larvæ which I took, emerged during the following week. They were placed in wide-mouthed bottles half-filled with water, and with sticks to climb up. Two of them emerged with the exuviae partly under the water; the third climbed about two inches above the water. All three were females. This leads me to believe that the males emerge considerably earlier, on the whole, than the females; and certainly their colouration, at the date of my visit, suggested that they were the more mature.

Having thus filled in the gaps in our knowledge in the life-histories of two species of this interesting genus, it remains to give descriptions of the full-fed larvæ, and to indicate their specific differences.

Description of Nymph of Diphlebia lestoides (Plate xix., fig. 1).

Total length 33 mm.

Colour dark brown, somewhat paler on legs; head and caudal gills almost black. Head 4.5 long by 5.6 mm. wide. *Eyes* black, rounded, widely separated; postocular lobes well rounded, slightly rough; just in front and below each eye is a series of six or seven sharp spines, which can be seen projecting from under the front border of the eye. *Frontal shelf* 1.3 long by 3 mm. wide, prominent. The huge *labium*, already fully described in my former paper (p. 378, and fig. 2), projects beyond and on each side of the front. *Antennæ* (fig. 5 of former paper) long and slender, 5.7 mm. in the specimen under description. *Ocelli* pale whitish, quite conspicuous. *Thorax*: *prothorax*, 1.5 long by 4.5 mm. wide, well developed, lateral lobes spiny, not angulated, their shape being rather bluntly sub-triangular, with the tip rounded off. *Meso- and metathorax* 5 mm. wide; *wing-cases* 7 mm. long; hind wing-case 1.2 mm. wide; reaching to end of fifth abdominal segment. *Legs*: *femora* flat and rather broad, smooth, those of fore and middle legs resting in a horizontal plane, but those of the hind-legs raised into a nearly vertical plane; measurement, fore 5.5, middle 6, hind 9 mm. *Tibiae* narrow, rounded, smooth; about 6 mm. long on all legs; *tarsi* short, fore 1.8, middle 2.6, hind 3.2 mm. *Abdomen* rather short, 12 mm.; 4 mm. wide at base, tapering to 2 mm. at segment 10. Each segment has a finely pitted, dorsal surface, but appears rather smooth and shiny; colour dark brown with no pattern. *Caudal Gills*: *median* 10.5, *laterals* 11.5 mm., each. The laterals lie in one plane pressing against the rock, but the median gill is held at a slight slant above them; when crawling, however, the median gill is often depressed so as to be almost level with the other two. *All three gills are*

strongly triquetral, the laterals being about 2.5 mm. broad at their greatest breadth, the median slightly narrower. The last 3 mm. of each gill consist of an attenuated tail, carrying some long irregular hairs. Colour a very dark brown. (Plate xix., fig. 3).

Hab.—Medlow, Blue Mountains, N.S.W. A unique specimen, taken November 13th, 1909.

Larval Type: the above unique specimen is in my collection.

Description of Nymph of Diphlebia nymphoides. (Plate xix., fig. 2).

This nymph is so similar in general appearance to that of *D. lestoides*, that it is only necessary to give the chief measurements, and to indicate the specific differences. The general colour is blackish above, dull-greyish beneath. This is of interest, as the basaltic rocks at Rocky Creek are grey or blackish, while the sandstone of the Medlow Creek is brown. Thus the colour of the larva approximates closely to that of the rock it inhabits. The nymph is slightly smaller than that of *D. lestoides*; total length 30-32 mm. *Head* somewhat narrower, about 5 mm. wide. *Antennæ* 5 mm., basal joint and base of second joint spiny; basal half of second joints and bases and tips of joints 2.5 white, not black (Plate xix., fig. 7). *Thorax* and *abdomen* very similar to those of *D. lestoides*. *Caudal gills* slightly narrower; laterals 10 mm., median 9 mm., with tails only 2 mm. long; shorter, thicker, and hairier than in *D. lestoides*. *Fore-legs* much smaller than in *D. lestoides*, the femur being 4 mm., and the tibia scarcely 5 mm. long. Upper surface of head and thorax strongly pitted all over; abdomen slightly less pitted.

A comparison of the tibia of the two species shews some small differences. In *D. nymphoides* (Plate xix., fig. 4) the lateral lobes are not quite so long as in *D. lestoides* (my former paper, fig. 2); and the innermost of the four teeth is not pointed, but somewhat blunt and nodding; the spines or

thick short hairs on the outer border are less regular; and the median lobe of the mentum is less indented and a little less prominent.

Hab.—Rocky Creek, Caroda, N.S.W. Taken December 14th, 1910.

Larval Type and co-types in my collection.

The Structure of the Larval Gizzard.

I have examined the gizzard of the larvæ of both species, and, as might be expected, there is very little difference. The dentition is arranged in sixteen fields or folds, eight of these being "major" folds and eight "minor." The gizzard of *D. lestoïdes* shews considerably greater regularity in the number of teeth on a fold than does that of *D. nymphoïdes*. Each fold is of considerable length, about 1 mm. in actual size, so that, in a "minor" fold, the teeth lie in a single longitudinal line, while, in a "major" fold, the teeth (a greater number) lie also in a longitudinal line, with a tendency to forming *two* lines at the upper end. In the gizzard of *D. lestoïdes*, the major folds each contained 11-12 teeth, the minor 8-9. In that of *D. nymphoïdes*, the major folds contained from 11-14; and the minor from 4-7, with one minor fold containing 8 teeth, and one very tiny extra tooth. Representing these tiny extra teeth by $\frac{1}{2}$, the teeth in this gizzard, taking the folds in order, were 7, 11, $8\frac{1}{2}$, 12, 7, 13, 6, 11, 5, 11, 4, $14\frac{1}{2}$, 5, 13, 4, 11. In *D. lestoïdes*, I noticed several isolated teeth lying low down outside the main folds; as many as three of these lay between two consecutive folds (see figure). In *D. nymphoïdes*, I found only one isolated tooth in the whole gizzard.

By comparing the figures given of one-half of each of the above gizzards, the greater irregularity of that of *D. nymphoïdes* is very evident. I should not like, however, to suggest that this difference is specifically constant, as I have examined only one gizzard of each species. Bearing in mind the extraordinary difference in the number of teeth in the

two gizzards of *Petalura gigantea* Leach, described by me in a former paper, we should be content, I think, to regard variations in the actual number of teeth on a fold as purely individualistic.

The type of longitudinal fold exhibited in these gizzards is, I believe, found in other *Calopterygid* larvæ whose gizzards have been examined. A somewhat similar longitudinal arrangement exists in the *Gomphine* larvæ; but, in these, there are only four folds, each containing a great many teeth, and shewing as many as three or four abreast on the upper portions. In the *Anisoptera*, it is certainly true that the larval gizzards determine the separation of the main groups, there being so far four main types known, viz., the *Libellulid* (*Libellulino-Corduline*), *Æschnine*, *Gomphine*, and *Petalurine*. If these are really four coordinate groups (a position which, I believe, could be easily maintained, and strengthened by many cogent arguments), we should seek to apply the same test to our admittedly unsatisfactory *Zygopterous* classification. I should like, therefore, to put it upon record now, though the elaboration of the facts must be left to later papers, that I have found the *Diphlebia*-form of gizzard to exist also in *Argiolestes* and *Isosticta* amongst the *Agrionidae*, though the gizzards of the legions *Agrion* and *Lestes* of de Selys are absolutely different. These facts suggest that the present *Agrionidae* are a collection of strongly *asthenogenetic forms descended along several main lines from more abundantly nervured insects*, of which the present-day *Calopterygidae* may represent, fairly closely, various stages of descent. In this manner, we can trace, from a common ancestor, in descending asthenogenetic order, the single group-line *Diphlebia*—*Argiolestes*—*Isosticta*, though we cannot perhaps regard any single one of these three genera as lying in the *direct* line of descent of the group; that direct line having most probably been lost. It may be added that the main structure and habits of the larvæ of these three genera, their caudal gills and their labia in particular, agree with this view. We

thus get a beginning of an insight into a natural scheme of classification for the *Zygoptera*, by means of which we may at last hope to separate fairly accurately, into coordinate groups, that great mass of asthenogenetic forms whose wing-venation has converged so remarkably, from widely different ancestral types, to one single petiolate wing-form.

In making the above statement, I am aware that I am traversing the received opinions of many profound students of the *Odonata*. If the above natural scheme be carried out, it can scarcely fail to indicate forms such as *Hemiphlebia*, *Selysioneura*, and a mass of genera in the legion *Protoneura*, not as highly archaic remnants, but as strongly specialised asthenogenetic or reduction-forms, many of which must be regarded as the most advanced *Zygopterid* types ever formed. A careful study of *Hemiphlebia* will, I believe, reveal that this is actually the case, and that the loss of the basal cross-vein in the quadrilateral of the fore-wing is the last and most advanced reduction-stage ever reached by any *Zygopterous* dragonfly; instead of being, as has been heretofore maintained, a remnant of an exceedingly archaic formation. It is time now, at any rate, that students of *Odonata* should refuse to be content with wing-venational studies only—though these must always play a most prominent part in all satisfactory schemes of classification—and that the evidence afforded by life-history studies, larval gizzards, and labia should be more carefully sought after, so that our knowledge of the *Odonata* may be made more complete and satisfactory.

Returning to the genus *Diphlebia*, it may be remarked that, though we must regard all *Calopterygidae* as more or less archaic in some degree, there is strong evidence that *Diphlebia* is one of the most advanced types in the family. It has evidently progressed far along the zygoterous line of advance, the amount of reduction of the præ-nodal area being very great for a *Calopterygid*. Of the six remaining antenodals, *two only* are continuous across the subcostal space. I think, too, that the practical fusion of the subcubital and radio-

median nervures in the wing of *D. nymphoïdes* ♂ is a strong proof of specialisation being successful in this genus. Who knows but that, in some far remote past age, an ancestor of the whole of the present *Odonata* brought about the fusing of the radius and median nervures in the same manner! One may wonder even that a petiolate wing with only four main basal nervures, subcubitus + radius + median forming an exceedingly strong second nervure, has not taken its place amongst the more highly specialised and successful zygopterous types of the present day.

Revision of the Generic Definition.

The characters of the genus, as defined by de Selys, need some slight modification, in order to include the four closely allied species now known. De Selys states, for instance, that in *Diphlebia*, there are sectors interposed between M_4 and Cu_1 . I find this to be the case only in a few of my specimens of *D. lestoïdes*, and then usually in the hind-wing. The divergence of M_4 and Cu_1 towards the margin of the wing results in an increase of the number of cell-rows from one to two, and finally to three or four at the wing-margin (Plate xx., fig. 1), but the borders of the rows are not usually straightened out into a true sector, but remain in the less specialised condition shewn in the figure. This generic character, therefore, needs revision. Another point is the position of departure of M_2 from M_1 . In most of my series, of all four species, M_2 continues in an almost unbroken curve from the nodus itself, though in some specimens there is a distinct, but not very sharp, break at the join. A third point is that de Selys describes the male superior appendages as "semi-circulaires, simples." This could hardly include the peculiarly shaped appendages of *D. hybridoides* with their large inferior spine. Again, de Selys says that the nodus in *Diphlebia* is placed a little less than one-half the wing-distance from the base of the wing. Taking *D. nymphoïdes*, the nodus is only

13 mm. from the base, whereas the total length is 31 mm., which seems to me rather too much for the "little, less," though that is only a personal opinion.

Further points of great importance, which differentiate this genus from *Devadatta* and all other *Calopterygine* genera, and shew it to be a close approximation to *Lestes*, are the absolute elimination of all cross-nervures in (a) the post-costal space above the petiolate anal vein, and (b) the whole space lying below R, from the arculus to the nodus. [In this connection it is also interesting to note that the position of the oblique vein is very variable in this genus. It is usually the *third* cross-vein from the join of M_1 with M_3 (see figure), but is not infrequently the *fifth*, and sometimes the *fourth*.] This line of specialisation, if continued until all but the first two antenodals were eliminated, the quadrilateral depressed and narrowed, and the distance between the arculus and nodus considerably lessened, would give us a close approach to a true *Lestine* wing.

The generic characters, amended on the above lines, will now be as follows—Two antenodals only, *viz.*, the one before and the one above the arculus, continued into the subcostal space. Quadrilateral, basilar space, postcostal space as far as the petiolation of the wing, and the whole of the space below the radius from the arculus to the nodus, free. Nodus lying at a distance *less than one-half but greater than one-third* of the whole wing-length, from the wing-base. M_2 departing from M_1 *under or very close* to the nodus. M_4 and Cu_1 diverging from one another slightly as they proceed to the wing-margin: a single row of cells at first between them, increasing to three or more rows, with or without distinct sectors. Superior appendages of male forcipate. Colour of male bright blue, with more or less black markings. Wings either clear or more or less barred or shaded.

Type, *Diphlebia lestoides*, Selys.

EXPLANATION OF PLATES XIX.-XX.

Plate xix.

Fig.1.—Nymph of *Diphlebia lestoïdes* Selys ($\times 1\frac{3}{4}$).

Fig.2.—Nymph of *Diphlebia nymphoïdes*, n.sp. ($\times 1\frac{3}{4}$).

Fig.3.—Caudal gills of nymph of *D. lestoïdes* Selys ($\times 3\frac{1}{2}$).

Fig.4.—Left lateral lobe and part of mentum of labium of nymph of *D. nymphoïdes*, n.sp. ($\times 12$).

Fig.5.—One-half of larval gizzard of *D. lestoïdes* Selys ($\times 30$).

Fig.6.—One-half of larval gizzard of *D. nymphoïdes*, n.sp. ($\times 30$).

Fig.7.—Antenna of nymph of *D. nymphoïdes*, n.sp. ($\times 9$).

Fig.8.—Set of spines under front border of eye in nymph of *D. nymphoïdes*, n.sp. ($\times 7$).

Fig.9.—Head of *D. lestoïdes* ♀, Selys, imago, to shew epicranial pattern ($\times 4\frac{1}{2}$).

Fig.10.—Head of *D. euphœoïdes* ♀, Tillyard, imago, to shew epicranial pattern ($\times 4\frac{1}{2}$).

Fig.11.—*D. nymphoïdes* ♀, n.sp., imago, to shew epicranial pattern ($\times 4\frac{1}{2}$).

[N.B.—Figs.9-11 are only intended to shew the *epicranial pattern*, and should not be taken as accurate in other details.]

Plate xx.

Fig.1.—Basal half of fore-wing of *Diphlebia nymphoïdes*, n.sp., ♂ ($\times 5$).

Fig.2.—Appendages of *D. lestoïdes* Selys ♂; *a*, dorsal; *b*, profile-view ($\times 10$).

Fig.3.—Appendages of *D. euphœoïdes* Tillyard ♂; *a*, dorsal, *b*, profile-view ($\times 10$).

Fig.4.—Appendages of *D. nymphoïdes*, n.sp., ♂; *a*, dorsal, *b*, profile-view ($\times 10$).

Fig.5.—Appendages of *D. hybridoides*, n.sp., ♂; *a*, dorsal, *b*, profile-view ($\times 10$).

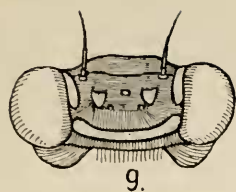
Fig.6.—Colour-pattern of abdomen of *D. lestoïdes* ♂; *a*, an individual from Jindabyne, N.S.W.; *b*, an individual from Heathcote, Illawarra, N.S.W. ($\times 2$).

Fig.7.—Colour-pattern of abdomen of *D. euphœoïdes* ♂ ($\times 2$).

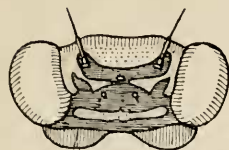
Fig.8.—Colour-pattern of abdomen of *D. nymphoïdes* ♂ ($\times 2$).

Fig.9.—Colour-pattern of abdomen of *D. hybridoides* ♂ ($\times 2$).

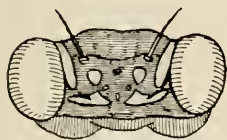
[N.B.—Figs.6-9 represent a jet-black pattern on a brilliant blue ground.]



9.



10.



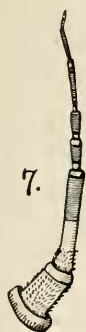
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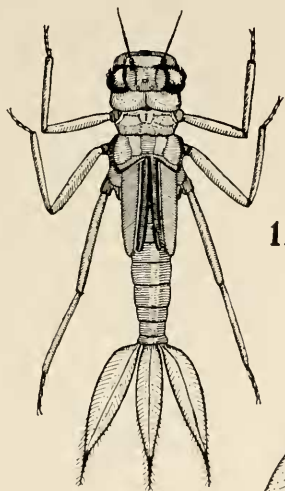
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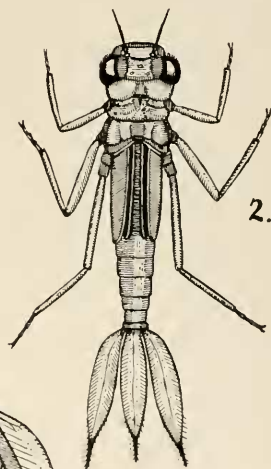
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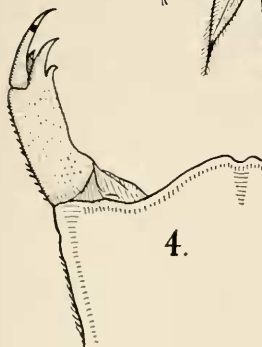
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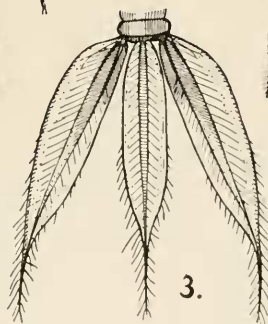
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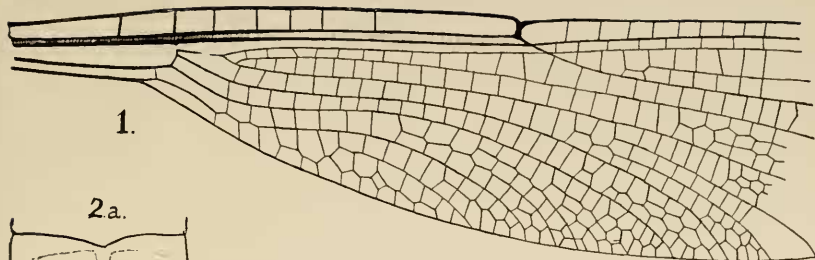


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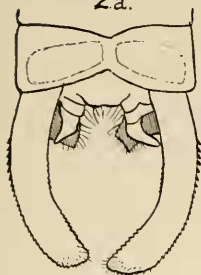
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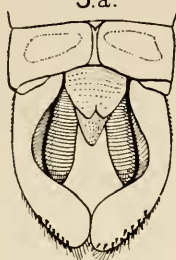


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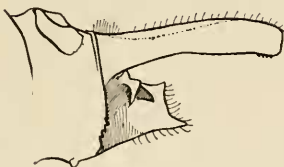
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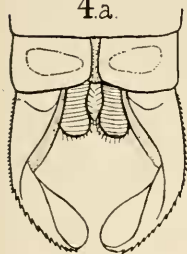
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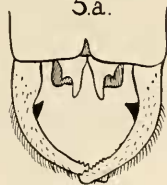
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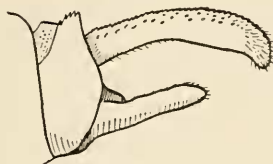
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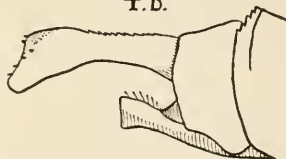
5b.



3b.



4b.



6a.



6b.



7.



8.



9.

